Research Note 84-29

DEVELOPMENT OF DESIGN GUIDELINES FOR USER/OPERATOR TRANSACTIONS WITH BATTLEFIELD AUTOMATED SYSTEMS: EXECUTIVE SUMMARY

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This document is an executive summary of a project to develop design guidelines for achieving more effective user transactions with battlefield automated systems. A methodology that has proved useful in deriving guidelines for higher order aspects of human-computer interaction is described. The method is based on a comparative analysis of common or universal transactions associated with existing data processing systems. The methodology, conceptual framework and format of the guidelines developed during the course of this project appear to provide a productive approach to improving the process of "technological transfer

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of data from human factors researchers to other members of system design teams involved in the design and development of battlefield automated systems. In addition, the concept of Behavioral Interoperability is propounded and discussed. Interoperability is recognized as an important design goal with respect to various physical/mechanical components of automated systems. The work here demonstrates that the concept can be productively extended to the behavioral domain.

The Battlefield Information Systems Technical Area of the Army Research Institute (ARI) is concerned with helping users and operators cope with the ever increasing complexity of the battlefield automated systems by which they acquire, transmit, process, disseminate, and utilize information. Increased system complexity increases demands imposed on the human interacting with the machine. ARI's efforts in this area focus on human performance problems related to interactions with command and control centers, and on issues of system design and development. Research is addressed to such areas as user-oriented systems, software development, information management, staff operations and procedures, decision support, and systems integration and utilization.

An area of special concern in user-oriented systems is the improvement of the user-machine interface. Lacking consistent design principles, current practice results in a fragmented and unsystematic approach to system design, especially where the user/operator-system interaction is concerned. Despite numerous design efforts and the development of extensive system user information over several decades, this information remains widely scattered and relatively undocumented except as it exists within and reflects a particular system. The current effort is dedicated to the development of a comprehensive set of human factors guidelines and evaluation criteria for the design of user/operator transactions with battlefield automated systems. These guidelines and criteria are intended to assist proponents and managers of battlefield automated systems at each phase of system development to select the design features and operating procedures of the human-computer interface which best match the requirements and capabilities of anticipated users/operators.

Research in the area of user-oriented systems is conducted as an in-house effort augmented through contracts with uniquely qualified organizations. The present effort was conducted in collaboration with personnel from Synectics Corporation under contracts MDA903-80-C-0094 and MDA903-82-C-0245. The effort is responsive to requirements of Army Project 2Q263744A793, Human Performance Effectiveness and Simulation, and to special requirements of the US Army Combined Arms Combat Developments Activity (CACDA), Fort Leavenworth, Kansas.

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DEVELOPMENT OF DESIGN GUIDELINES FOR USER/OPERATOR TRANSACTIONS WITH BATTLEFIELD AUTOMATED SYSTEMS

BRIEF

Requirement:

To develop a methodology that provides a framework and format for a comprehensive set of human factors guidelines for the design of user transactions with battlefield automated systems for use by human factors specialists and system proponents, managers and developers.

Procedure:

To meet the requirements stated above, a three phase research program was initiated. Phase I was devoted to defining human factors requirements for battlefield automated systems and establishing a framework within which guidelines could be organized. In Phase II, the technical data base was further developed through search of the military and civilian literature related to user/operator transactions with automated data processing systems and a prototype handbook of guidelines was developed. When guidelines were available in the literature, they were reworded as necessary for consistency of expression and/or modified to conform to the newly established framework. Other guidelines were written on the basis of project staff experience, modulated by the results of the analytic activities during Phase I.

During Phase III, the provisional guidelines were applied to the soldier/machine interfaces of two battlefield automated system developmental programs, each at a different stage of development. These application efforts provided the basis for refinement of the format and methodology for developing such guidelines. Modifications were made to the guidelines and they were republished.

Findings

Guidelines in the literature were plentiful in the areas of data entry and error handling. There was also substantial information on coding and display formats. For other topics, little or no information was available. Thus, approximately half of the guidelines were written by the project staff.

Utilization of Findings:

The methodology, conceptual framework and format of the guidelines developed in the course of this project appear to provide a productive approach to inproving the process of "technological transfer" of data from human factors researchers to other members of system design teams of battlefield automated systems. The development of an officially sanctioned set of guidelines will require interaction and coordination between many Army agencies. This handbook will provide a stimulus for such interaction. In the meantime, judicious application of these guidelines will improve the effectiveness of the soldier/machine interface of future systems and will promote the behavioral interoperability of these systems, i.e., increase the degree to which skills and knowledge can be transferred from one system to another.

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- Decreasing soldier population
- Decreasing skill levels
- Increasing data processing requirements
- Increasing data processing sophistication
- Emerging technologies

SOLDIER-MACHINE INTERFACE (SMI) USER/OPERATOR REQUIREMENTS

- Reduce error rates
  - Unburden input
  - Reduce memory load
  - Simplify procedures
- Reduce system throughput time
  - Reduce correction requirements
  - Reduce off-line references
  - Decrease number of transaction steps
- Increase user/operator acceptance
  - Reduce frustration
  - Facilitate quicker results
  - Reduce effort per transaction

THE SOLUTION

- Three phase effort
- Guidance to designers
- Design to human capabilities, not equipment capabilities
- Comprehensive set of design guidelines and criteria

OBJECTIVES

- Reduce training requirements
- Enhance human performance in battlefield automated systems
- Human factors technology available to system proponents, designers
- Performance criteria suited to application during system development

THE APPROACH

- Survey battlefield automated systems--obtain data on user/operator transactions
- Identify problems and deficiencies in user/operator transactions--a real world foundation on which to build
- Develop solutions to observed and anticipated problems:
  - Prototype handbook of design guidelines and criteria
  - Validate the guidelines against battlefield automated systems in different stages of development

ACTIVITIES OVERVIEW

- Phase I
  - Survey Battlefield Automated Systems
  - Build data base
  - Review guidelines literature
  - Establish guidelines structure
  - Prepare preliminary guidelines
- Phase II
  - Review human-computer literature
  - Review the Life Cycle System Management Model (LCSMM) to determine guideline needs at different stages of development
  - Develop Prototype Design Handbook for Combat and Materiel Developers (the guidelines and criteria)
- Phase III
  - Validate guidelines and criteria against two Battlefield Automated Systems at different stages of design
  - Obtain system developer reaction to guidelines and criteria
  - Conduct in-house review of guidelines and criteria
  - Develop recommendations for revision of the guidelines
  - Republish the Prototype Design Handbook for Combat and Materiel Developers

ANALYSIS OF BATTLEFIELD AUTOMATED SYSTEMS

- Review of more than 60 systems
  - Battlefield Automated Management Plan (BAMP)
  - Army Battlefield Interface Concept (ABIC) '79
- In-depth review of 12 systems:
  - TACFIRE
  - TOS[2]
  - TCT
  - DLDED
  - DS4 Auto Run Book
  - Phoenix Auto Run Book
  - MAGIS (USMC)
  - ISIS (Rand)
  - IISS
  - SDA (USMC)
  - BCS
  - DAS3
- Substantive analyses and reports on 5 systems:
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  - Tactical Computer Terminal (TCT)
  - Admin/Log Automated Systems
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ORGANIZING FRAMEWORK FOR GUIDELINES AND CRITERIA

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  - Graphics Control Methods
  - HELPs
- Display Techniques
  - Alphanumeric Displays
  - Graphics Displays
  - Selective Highlighting
- Data Entry and Handling
  - Information on Legal Entries
  - Unburdening of Input
  - Interrupts and Work Recovery
- Message Composition Aids
  - Composition Aids for Alphanumeric Messages
  - Composition Aids for Graphics Displays
- Data Retrieval Assistance
  - Query Method
  - Query Structure
- Symbology and Terminology
  - Symbols and Symbol Sets
  - Standard Terms
  - Abbreviations and Codes
  - Full Language
  - Glossaries
- Error Handling
  - Error Feedback
  - Error Correction/Recovery
- User/Operator Configurations

RESULTS OF PHASE III GUIDELINES VALIDATION

- Application to two battlefield automated systems:
  - Vehicle Integrated Defense System--Data Management System (VIDS-DMS)
  - Vetronics--Application of vehicle electronics to future ground combat vehicles
- Prototype guidelines appropriate and useful at different stages of system design
- Prototype guidelines republished in ARI Technical Report 83-____
  - Format and structure consistency improved
  - Index added

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SECTION 2. ACTIVITIES, PRODUCTS, AND RESULTS

Introduction

This document contains a summary of activities and products of a three phase effort to develop and validate guidelines and criteria for user/operator transactions with US Army battlefield automated systems.

The Need Addressed

Automation of the battlefield, rather than reducing the human skills required, imposes demands for different and higher order skills than the more conventional battlefield. Personnel issues associated with development of battlefield automated systems arise in three specific areas:

1. The Soldier-Machine Interface (SMI). Traditionally, the system designer's attention has focused more on the machine end of the system than on the human aspect and has counted on the adaptability of the user/operator to compensate for any design inadequacies. Too little attention to user/operator skills and capabilities, compounded by the explosion of information which automation allows, have greatly exaggerated SMI problems. Systematic attention to human engineering features of the equipment and especially to human factors features of the software interface could unburden the Soldier-Machine Interface.

2. Design Inconsistency. Independent development of battlefield automated systems fosters unique configurations and procedures. The lack of coordination among system proponents and developers imposes another dimension to the SMI problem, that of learning new equipment and procedures when transferring from one system to another, and sometimes even from one duty station to another within the same system. A more consistent approach to system design could reduce this negative effect of prior experience.

3. Personnel Insufficiency. Despite predictions during early phases of automation for reduced numbers and levels of personnel, just the opposite has been true. Expanding availability and increasing complexity of new battlefield systems impose additional burdens on recruitment and training of

personnel. The Army faces a further compounding of the problem: its skills pool has been contracting rather than expanding. Human engineering design for ease of operation and maintenance promises some help. Of equal, if not greater need, however, is attention to design which will allow greater numbers of less skilled personnel to competently perform as system users/operators.

The Proposed Solution

The Army Research Institute for the Behavioral and Social Sciences (ARI) proposed a three phase effort to address the above problems. The effort was to provide guidance for the design of Soldier-Machine Interfaces which focus on design to human capabilities rather than on design to equipment capabilities. The proposed solution was to develop and validate a comprehensive set of human factors guidelines and criteria for use by human factors specialists and system proponents, managers, and developers in the design of user/operator transactions with battlefield automated systems.

Phase I Activities and Results

The objective of the first phase of the Guidelines Project was to build a data base from which to develop a preliminary set of guidelines and criteria for user/operator transactions with battlefield automated systems. The intent of this first stage of guidelines development was to provide a framework and preliminary data by which to eventually provide to the system design team the tools necessary to capitalize on human capabilities and to compensate for human limitations, thereby enhancing human performance and facilitating coordination among proponents and developers.

As an initial step, a survey was conducted of all battlefield automated systems. The survey began with a review of the Battlefield Automated Management Plan (BAMP) and the Army Battlefield Interface Concept (ABIC). This documentation permitted review of more than 60 battlefield automated systems, but unfortunately, at a more reduced level of data on human factors issues than had been anticipated. Neither the BAMP nor the ABIC'79 provided substantive data on human factors issues of concern. In order to acquire the

level of information deemed necessary to provide an adequate data base for the guidelines, detailed analyses were conducted of a series of systems. Data were gathered by two principal methods: interview of subject matter experts and/or developer personnel and thorough review of available documentation to extract information about system design features and operating procedures that would affect user/operator interaction with the system.

Two techniques were developed through which to record and manipulate the data. The Transaction Feature Analysis technique was devised for providing a six-step narrative description of a system design feature and its effect on system performance. A comparable technique, Transaction Compatability Analysis, was derived to present comparison of similar design requirements either across systems or across different portions of a single system.

During these analyses, a variety of structures was explored within which to set forth the design guidelines. Inspection of classification schemas in the human factors literature revealed a lack of consistency and frequently a structure and/or language too psychologically oriented for ready application by the intended users of the handbook. Accordingly, one of the principal goals of Phase 1 was to develop a method of data presentation that was more suitable to the needs of the analysts and engineers typically involved in the process of system development and system engineering.

The Phase I effort culminated in a Final Report organized as follows:

Volume I: Executive Summary

Volume II: Technical Report

Volume III: In-depth Analyses of Individual Systems

- A. Tactical Fire Direction System (TACFIRE)
- B. Tactical Computer Terminal (TCT)
- C. Division Level Data Entry Device (DLDED)
- D. Intelligence Information Subsystem (IISS)
- E. DS4 Automated Run Book

Volume IV: Provisional Guidelines and Criteria

Volume V: Background Literature

Table 1

Organizing Framework for the Survey of Battlefield Automated Systems

1. Control Methods
   - 1.1 Alphanumeric Control Methods
   - 1.2 Graphics Control Methods
   - 1.3 HELPs
2. Display Techniques
   - 2.1 Alphanumeric Displays
   - 2.2 Graphics Displays
   - 2.3 Selective Highlighting
3. Data Entry and Handling
   - 3.1 Information on Legal Entries
   - 3.2 Unburdening of Input
   - 3.3 Interrupts and Work Recovery
4. Message Composition Aids
   - 4.1 Composition Aids for Alphanumeric Messages
   - 4.2 Composition Aids for Graphics Displays
5. Data Retrieval Assistance
   - 5.1 Query Method
   - 5.2 Query Structure
6. Symbology and Terminology
   - 6.1 Symbols and Symbol Sets
   - 6.2 Standard Terms
   - 6.3 Abbreviations and Codes
   - 6.4 Full Language
   - 6.5 Glossaries
7. Error Handling
   - 7.1 Error Feedback
   - 7.2 Error Correction/Recovery
8. User/Operator Configurations

Table 2

Guidelines Format

X.X.1	DEFINITION. Defines the category of guidelines and criteria covered in the subsection.
X.X.2	APPLICATIONS. Describes the situations to which guidelines and criteria in the subsection apply. Examples are provided to illustrate the applications.
X.X.3	BENEFITS. Describes the ways in which utilization of the guidelines will enhance system performance. Descriptions of benefits, interpreted in terms of the specific system's characteristics, can be translated into evaluation criteria.
X.X.4	METHODS. Describes specific methods for implementing the guidelines in the subsection. Examples are provided liberally to clarify each method.
X.X.5	RECOMMENDATIONS. Contains specific guidelines which apply across all methods in the subsection. Usually, the first recommendation in each subsection is a matrix of applications versus methods, suggesting specific methods to use for each application.
X.X.6	ADVISORY COMMENTS. Contains specific guidelines for each method in the subsection.

Phase II Activities and Results

The objectives of the second phase of the effort were to:

1. Develop the technical information required for fuller generation of guidelines and criteria.

2. Develop a prototype handbook of guidelines and criteria to address the problems and deficiencies in the soldier-system interface of battlefield automated systems and on information developed in pursuit of the first objective.

A review of the literature (Parrish, Smith, Gates, and Munger, 1981) related to human-computer interaction conducted early in the second phase demonstrated that much of what is presented in the literature is too general to be of use to system developers as specific design guidance. The most useful documents were those published by Engel and Granda (1975), Ramsey *et al* (1978), Smith (1974, 1979, 1980), and Williges and Williges (1981). Each of these reports addresses human-computer guidelines directly, and each provides specific guidelines in at least one area of user/operator transactions.

This second phase literature review yielded insights and concepts that extended and supplemented the preliminary literature search of the first phase of the study (Volume V of the Phase I Final Report). It provided little additional material that could be directly expressed as guidelines, thereby reinforcing the earlier conclusion that material relevant to the purposes of the project are fragmented and more useful as indicators of what work needs to be done than of information which directly contributes to the development of guidelines and criteria.

During this second phase of the effort, the primary focus was on actual development and presentation of the guidelines and criteria. A major and early consideration in this effort was development of guidelines appropriate to each stage of system development as defined by the Life Cycle System Management Model (LCSMM). Initial planning for the prototype handbook, therefore, envisioned a developmental stage orientation within the organizing

framework presented in Tables 1 and 2. In the end, specific breakout of guidelines by stage of development was abandoned due to the following:

1. Much of the material in the early stages sections of a design stage oriented handbook would have duplicated work under another ARI contract (Sawyer, Fiorello, Kidd, and Price, 1981) which produced a human factors "principal product" concept for each stage of the LCSMM. Although not directly stated as guidelines, at least for early design stage, the descriptions of the processes for obtaining the principal products essentially constitute a series of recommendations or guidelines appropriate to that stage.

2. For much of the other aspects of the guidelines and criteria presentations (e.g., definition, application), materials would basically replicate the content presented for early design and merely inflate the prototype handbook.

For these reasons, the development of guidelines appropriate to each stage of system development was abandoned pending the results of the third, or validation, phase of the project.

The Prototype Design Handbook for Combat and Materiel Developers was published as Volume II of the Final Report of Phase II of the study. (Volume I presents a discussion of the Phase II activities and products. See Volume III of this report, Section 4, for a full list of publications which evolved during the full study effort.) The handbook is organized according to the framework and discussion topics presented in Tables 1 and 2. An introduction to the handbook discusses sources of information for guidelines and provides instruction to the user on its use. A few comments of noteworthy characteristics of the handbook are appropriate.

1. In developing the design guidelines within the framework outlined in Tables 1 and 2, the first four topics of Table 2 (Definition, Applications, Benefits, and Methods) characterize the subtopics of Table 1, while the last two topics (Recommendations and Advisory Comments) provide specific guidance for selecting and then implementing appropriate design techniques.

2. In developing the specific guidelines presented within Recommendations and Advisory Comments from the literature

   inconsistency of language was a major problem. The majority of the guidelines derived from the literature were reworded or entirely rewritten to achieve consistency in style, to provide greater emphasis, to sharpen their focus, to remove psychological jargon, or to increase their clarity of expression.

3. As noted earlier, many of the guidelines topics were addressed only generally or very sparsely in the literature. For these areas, guidelines were developed on the basis of the knowledge and experience of the project staff. Guidelines for individual sections of the handbook were prepared by different personnel and then reviewed by others, with differences of opinion reduced through discussion. It is judged that guidelines thus generated comprise about half of the content of the handbook.

4. Creation of guidelines from experience yields guidelines which are, as yet, neither supported nor challenged by the results of research, and which inevitably reflect the prejudices of the project staff. Nonetheless, they reflect application in human-computer interface development efforts on which project personnel have worked and they also reflect solutions devised for problems and deficiencies observed during the analytical activities of the first phase of the project.

Figure 1 presents sample guidelines for Display Techniques. Figure 2 presents sample guidelines for Graphics Displays.

Phase III Activities and Results

The objectives of the third phase of the effort were to:

1. Demonstrate the applicability of the guidelines and criteria.

2. Obtain system developer reaction to the guidelines.

3. Develop recommendations for revision of the guidelines.

Two battlefield automated systems at different stages of development were selected for application of the design guidelines and criteria contained in the prototype handbook. Applications of the guidelines were addressed to:

1. The Vehicle Integrated Defense System - Data Management System (VIDS-DMS), a self protection system under development by the US Army Development and Readiness Command (DARCOM), through the Concepts Laboratory at the Research and Development Center of its Tank - Automotive Command (TACOM). At the time of applciation of the guidelines to the VIDS-DMS, development plans called for the design, development, and test of a Feasibility Demonstration Model which emphasized the data management aspects of the system. Information was gained primarily through review of the draft procurement specification[1] and through discussion

[1] Draft Procurement Specification: Vehicle Integrated Defense System - Data Management System (VIDS-DMS). Warren, MI: US Army Tank - Automotive Command Research and Development Center, July 1982. (R-3760-10279)

SECTION 2. DISPLAY TECHNIQUES

Guidelines in this category specify methods for information presentation which contribute to user/operator accuracy and efficiency in information presentation and utilization. Speed, ease, and accuracy of comprehension are important factors here. Display techniques are considered within the following three categories:

1. Alphanumeric Displays describes conditions and techniques appropriate to generation of displays for alphanumeric data presentation.

2. Graphics Displays describes conditions under which pictorial and diagrammatic presentation of information are appropriate and delineate techniques for achieving optimum presentation.

3. Selective Highlighting describes techniques for differentiating displayed items which are of special interest to the user/operator from those which are more routine.

2.1 Alphanumeric Displays

2.1.1 DEFINITION

Alphanumeric displays are screen or hard-copy presentations of information composed of the alphanumeric symbol sets. (See the discussion of symbols and symbol sets in Section 6.1.) To the extent that grammatical symbols are required for textual separation, or that special symbols associated with a specific area of science or technology are required, fixed alphanumeric displays also contain these additional symbols and symbol sets.

Figure 1. Sample Guidelines for Display Techniques

2.1.2 APPLICATIONS FOR ALPHANUMERIC DISPLAYS

Alphanumeric displays are appropriate for:

a. Presentation of layouts for data entry.

EXAMPLE: In a field artillery system, all information is entered within a selected prestructured message format. The format consists of data field labels, data field delimiters (made up of grammatical symbols), and spaces for data element entry. All entries are alphanumeric codes. Data entry length can not exceed the space allowed, and only proper information (legal entries) can be entered within a given data field.

of data f

tries and the repo

cine" to "emergency."

c. Display of a list of performance or other options (menu).

EXAMPLE: A tactical intelligence data handling system functions, in part, through user/operator call-up of preformatted displays and, in part, through the use of menus. Once the user/operator logs onto the system, a list of the machine's functions--a master menu--is automatically presented on the screen. Selection of a function from the master menu results, in some instances, in presentation of preformatted displays through which the user/operator constructs command statements to perform fu vailable in that mode of operation.

2.1.3 BENEFITS OF ALPHANUMERIC DISPLAYS

Proper utilization of alphanumeric displays will enhance overall system performance through improved user/operator performance by:

a. Reducing error rates, by minimizing:

1. The necessity for recalling information from memory due to insufficient display of essential information.

2. Suboptimum display formats which make discriminations between separate items of information difficult.

3. Improper retrieval of essential information due to inappropriate code and/or features of information presentation

4. Difficulty in distinguishing among logical subelements of a data item which is required for subsequent command or data item entry.

b. Increasing system throughput rates, by minimizing:

1. Difficulty in locating information displayed on the screen.

Figure 1. (Continued)

2.1.4 METHODS FOR ALPHANUMERIC DISPLAYS

Alphanumeric displays are of two basic types: fixed and variable.

a. Fixed alphanumeric displays. Fixed alphanumeric displays cannot be varied by the user/operator in shape, size, or data element label. Fixed alphanumeric displays can be provided through the following methods:

1. Lists of appropriate information. These lists can take any of a variety of forms.

(a) Lists may be in the form of legal codes as follows, for example, for ammunition type:

•
•
•

(b) Lists may be in the form of code definitions, as follows, for ammunition type codes:

•
•
•

2.1.5 RECOMMENDATIONS FOR ALPHANUMERIC DISPLAYS

a. Table 2.1-1, Method of Alphanumeric Display by Application, presents general recommendations for the use of particular [illegible] of our [illegible]red by the

Table 2.1-1. Method of Alphanumeric Display by Application

KEY

1 - RECOMMENDED

2 - ACCEPTABLE

3 - WORKABLE BUT SUBOPTIMAL

4 - NOT RECOMMENDED OR NOT APPLICABLE

METHOD	APPLICATION				
	[illegible] FOR DATA ENTRY	DATA DISPLAY FOR INFORMATION OR ACTION	DISPLAY OF MENUS, PROMPT OPTIONS	PRESENTATION OF HELPS	PRESENTATION OF ERROR INFORMATION
FIXED ALPHANUMERIC DISPLAYS					
LISTS	4	1*	1*	2	3
PRESTRUCTURED FORMATS	1	1	2	2	2
HELPS	4	1	2	1	4
ERROR MESSAGES	4	2	3	4	1
VARIABLE ALPHANUMERIC DISPLAYS					
FREE TEXT REPORT	2	2	1	4	4
SUCCESSIVE [illegible] FILES	2	2	1	2	2

*RECOMMENDED AS THE CHOICE FOR STANDARDIZATION PURPOSES

Figure 1. (Continued)

2.1.6 ADVISORY COMMENTS FOR ALPHANUMERIC DISPLAYS

a. Fixed alphanumeric displays

1. Build fixed formats for alphanumeric data in accordance with the source data. Allow space for the longest legal entry; if grouping of data elements is required, make the groupings agree with those of the source data. Do not vary formats for identical data element structures.

2. Give each display frame a unique identifier, i.e., a name or a number. When multiple frames are necessary to complete a display, give each display frame an identifier which shows how that frame fits into the total picture.

   EXAMPLE: PERS LIST, FRAME 1 OF 4

3. Identify all fixed fields with a field label. Even frequently used fields having a standard format need a field label.

   EXAMPLE: DATE:__/__/__; (for month, day, year.)

4. Left justify text and other alphanumeric formatted data, Right justify numerical/tabular data. Do not require leading zeros in numerical data except where needed for precision.

EXAMPLE:	USE	DO NOT USE
NUMBER OF TANKS:_____;	17	000017
NUMBER OF SOLDIERS:_____;	66	000066
RATIO: SOLDIERS TO TANKS:_____;	3.882	03.882
RATIO: TANKS TO SOLDIERS:_____;	.258	000.258

5. Design the fixed format for data input to match the output unless such requirements impose difficulty or overburdening on the user/operator.

6. When providing on-line HELPS and/or error messages, present them each in a consistent format and at a consistent location on the screen.

7. Make HELPs and error messages clear, concise, and self-contained. That is, provide all necessary information for helping in the data entry or correction without sending the user/operator to external data sources.

8. Make terminology used in HELPs and error messages consistent with terminology used elsewhere in the system.

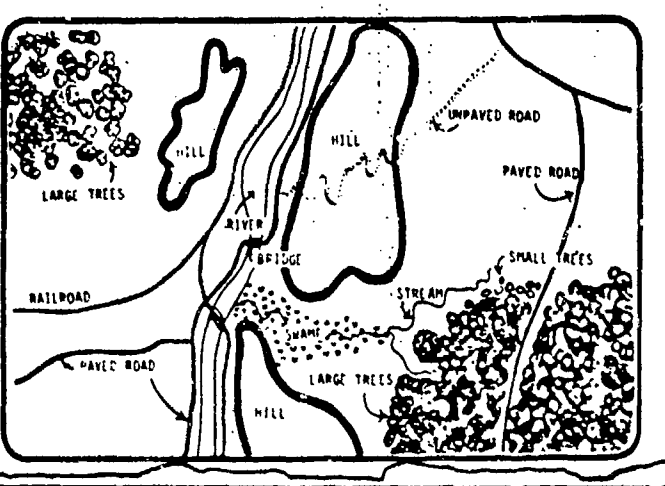
Figure 1. (Continued)

4.2.2. APPLICATIONS FOR COMPOSITION AIDS FOR GRAPHICS DISPLAYS

Composition aids for graphics displays are appropriate for user/operator use in:

a. Creation of maps and charts.

EXAMPLE: The tank battalion commander requests that one of the forward tanks provide a description of the terrain immediately ahead. The user/operator in the lead tank creates a rough map of the area by sketching with a light pen and calling up standard mapping symbols already stored in the machine and placing them at appropriate locations on the map. Alphanumeric identifiers are also added to call out important terrain features. The display is then transmitted to the tank battalion commander.



4.2.5 RECOMMENDATIONS FOR COMPOSITION AIDS FOR GRAPHICS DISPLAYS

a. Table 4.2-1 presents recommendations for using particular methods for aiding the user/operator in composition of graphics displays. Before deciding to use one or more of these methods, review the general recommendations that follow and consult the advisory comments on specific methods contained in Section 4.2.6.

Table 4.2-1. Methods for Aiding Graphics Display Composition by Type of Format Application

KEY:
1 - RECOMMENDED
2 - ACCEPTABLE
3 - WORKABLE BUT SUBOPTIMAL
4 - NOT RECOMMENDED OR NOT APPLICABLE

METHOD	APPLICATION: TABLES AND LISTS	MAPS OR PICTURES	SCHEMATICS, ETC	FILL-IN FORMS, MENUS, SKETCHES	TRACING
DIRECT ENTRY FROM SYSTEM DATA	2	1*	1*	2	1
USER/OPERATOR ENTERED DATA	1*	1	1	2	2
LABELED MENUS	3	2	2	4	4
DIGITIZATION	1	2	2	4	1*
JOYSTICK, LIGHT PEN, TRACKBALL, ETC	2	2	2	1*	2
TOUCH SENSITIVE SURFACE	2	2	2	1	4

*Recommended as 1st choice for standardization purposes

Figure 1. (Continued)

with personnel at TACOM with responsibility for VIDS development.

2. Vetronics, the Army's concept of vehicle electronics, which is the application of electronics technology to future ground combat vehicles analogous to the aviation community's Avionics concept. Vetronics information was restricted to broad conceptualizations of functions/applications presented in two briefings.[2] Discussion was also held with persons at TACOM having responsibility for further development of Vetronics concepts.

The guidelines were applied against selected functions of both the VIDS-DMS and Vetronics. Because of the relative stages of development of the two systems, the two applications afforded very different contexts for guidelines usage. For both systems it was possible to provide both general and very specific guidance to the system developers, as can be seen in the substantive reports provided in ARI Research Note 83-__. The Vetronics report is presented in Section 1 and the VIDS-DMS report is presented in Section 2 of this report. With respect to the applicability of the guidelines to the two systems, the format and content of the guidelines are conducive to their use at different stages of development. At very early stages, review of the Methods and Recommendations sections in particular provide good indications for general appropriate design solutions. As development progresses, the more detailed information specific to design options presented as Advisory Comments becomes appropriate. More detailed analyses and results of applications of the guidelines and recommendations for their further improvement are presented in the next subsection of this section of the report.

In addition to the application of and developer reaction to the guidelines, an in-house review by the project staff and others was carried out to address ways in which the guidelines could be improved. With the exception of primarily modest modifications which have been made to the guidelines, results of these reviews are also reflected in the next subsection of this report.

[2] The Armored Combat Vehicle Technology Concept Plan, presented by the US Army Tank - Automotive Command (TACOM) to the Armored Combat Vehicle Science and Technology Program Advisory Council, 11 February 1982 and the Vetronics Action Team (VAT) Briefing, presented to the Program Advisory Council for the Tank Science and Technology Base Program by the VAT Chairman, 11 February 1983.

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